

# 2018 Consent Decree (CD) Leak Detection and Repair (LDAR) Audit

## BP Husky – Toledo Refinery

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January 17, 2019



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## 1

## EXECUTIVE SUMMARY

TRICORD Consulting, LLC (TRICORD) conducted a leak detection and repair (LDAR) program audit at the BP – Husky Toledo Refinery in Oregon, OH. The audit followed the requirements specified in the site’s 2001 Consent Decree (CD) and the applicable<sup>1</sup> provisions of the draft 2018 Consent Decree which included comparative monitoring, recordkeeping, component identification, and observations. This audit serves as the initial audit required by the draft 2018 Consent Decree. In addition to the CD audit requirements, open-ended line (OEL) and sample system control regulatory standards were focus areas as these requirements can have a significant effect on LDAR compliance.

For comparative monitoring of valves, the auditors monitored a total of **740** valves in three process units. For the ISO 2 unit, the audit leak rate (0.74%) was higher than the site’s historical average (0.34%). For the Ref 3 unit, the audit leak rate (0.41%) was higher than the site’s historical average (0.30%). For the BGOT unit, the audit leak rate (0.00%) was slightly lower than the site’s historical average (0.03%). The audit leak rate on all of the units were within the site historical leak rate range, and statistical analyses indicate that site and audit leak rates were in good agreement. This indicates that the site is correctly monitoring per 40 Code of Federal Regulations (CFR) Part 60 Appendix A Method 21 (Method 21) to identify leaks.

For comparative monitoring of pumps, the auditors monitored a total of **44** pumps in three process units. For the ISO 2 unit, the audit leak rate (0.00%) was lower than the site’s historical average (0.90%). For the Ref 3 unit, the audit leak rate (0.00%) was the same as the site’s historical average (0.00%). For the DHT unit, the audit leak rate (0.00%) was the same as the site’s historical average (0.83%). The audit leak rates on all three of the units were within the site historical leak rate range, and statistical analyses indicate that site and audit leak rates were in good agreement. This indicates that the site is correctly monitoring per 40 Code of Federal Regulations (CFR) Part 60 Appendix A Method 21 (Method 21) to identify leaks.

For recordkeeping, the audit examined records from 3<sup>rd</sup> Quarter 2016 to 2<sup>nd</sup> Quarter 2018. In total, more than **564,643** record items were reviewed across thirty-four (34) compliance areas. A number of preliminary issues were identified, and most issues were explained by additional documentation with seven (7) compliance findings.

<sup>1</sup> Applicable as specified in paragraphs 29(a), 29(b), and 29(c) of the draft 2018 Consent Decree. Note the first (initial) audit required by the draft 2018 Consent Decree does not require auditing other provisions of the [draft 2018 consent decree required] LDAR Program as specified in the last sentence of paragraph 29 as written “In addition to these items, LDAR audits after the first audit shall include reviewing the Toledo Refinery’s compliance with this LDAR Program.”

For component identification, the audit reviewed the component inventory in three process units as well as the Management of Change (MOC) process. The auditors found zero (0) components that had been omitted from the program out of an estimated 4,332 components inspected.

Observations were conducted by members of the audit team. The refinery procedures were found to comply with Method 21. The observed individual demonstrated highly effective knowledge and possession of the necessary skills to identify and repair leaking equipment.

The audit also inspected the three units selected for comparative monitoring for other LDAR compliance issues. This inspection found one (1) open-ended line (OEL) without control by cap, plug, blind flange, or double block valves. An estimated total of 866 potential OELs were inspected.

Overall, TRICORD found the site to be in compliance with the LDAR provisions of the CD, as well as the applicable Federal and local LDAR regulations, with the exception of the findings detailed in **Section 4**.

## 2

INTRODUCTION

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TRICORD conducted a leak detection and repair (LDAR) program audit at the BP – Husky Toledo Refinery in Oregon, OH. The audit followed the requirements specified in the site’s 2001 Consent Decree (CD) and the applicable provisions of the draft 2018 Consent Decree CD. This audit team consisted of:

- Team Lead – Mark Kelsey
- Field Auditor 1 – Jim Walsh
- Data Auditor 1 – Matthew Kessing
- BP ECAT Participant – John Wigger

Based on applicability information provided by the site the following regulations italics and underlined below were audited against:

- Federal Regulations
  - 40 CFR Part 60 Subpart GGGa/VVa;
- United States Environmental Protection Agency (US EPA) Consent Decree(s)

The audit lasted four (4) onsite days, from November 26, 2018 to November 29, 2018, which included, but was not limited to, comparative monitoring, recordkeeping, component identification, and observations.

The sections herein document the methods used to evaluate the program as well as the specific results.

**3****AUDIT SCOPE AND METHODOLOGY**

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In this section, the audit scope and methodologies used to execute the audit scope are discussed.

**3.1 Comparative Monitoring (Valves)**

The auditors conducted comparative monitoring on 740 valves across three (3) units. Comparative monitoring is performed on a random basis depending on the component monitoring target, which is determined by the normal to monitor valve population and process unit leak rate. The auditors traversed the entire process unit monitoring selected gas vapor and light liquid valves in semi-random fashion. Only normal to access valves are considered, e.g. no fall protection or other safety precaution necessary for inspection. For example, the auditors may select a process unit with 1,000 normal to monitor valves and a component count monitoring target of 50%. In this example, the auditors would approach the unit at one end and monitor every other valve until they have worked their way to the opposite side of the process unit. Mechanical tally counters log each inspection. The audit team records leaking valve information in a field notebook and reports these issues to the facility for resolution.

For the audit, the selected units for comparative monitoring were the ISO 2, Ref 3, and BGOT units. The percentages of valves monitored in each unit were approximately 12%, 18%, and 23% for the ISO 2, Ref 3, and BGOT units, respectively. Cumulatively, this represented approximately 16% of the total LDAR valve population in the refinery or about 16% of the valves in the three units inspected.

**3.2 Comparative Monitoring (Pumps)**

The auditors conducted comparative monitoring on 44 pumps across the three (3) units. Comparative monitoring is performed on a large portion of the pump population, as the small sample sets allow for single leaks to present large leak rates. Mechanical tally counters log each inspection. The audit team records leaking pump information in a field notebook and reports these issues to the facility for resolution.

For the audit, the selected units for comparative monitoring were the ISO 2, Ref 3, and BGOT units. 100% of all pumps were monitored in each unit.

**Recordkeeping**

The refinery utilizes LeakDAS Desktop Database Management System to electronically record and store the majority of the LDAR Program recordkeeping and documentation. Those records not maintained in LeakDAS were reviewed onsite or electronically offsite. These records included:

1. Facility Written Plan
2. Training Records
3. Daily Calibration Records
4. Quarterly Calibration Records

As part of the audit process, TRICORD performed a database review to evaluate the effectiveness and accuracy of the recordkeeping procedures at the facility. The database period audited included the 3<sup>rd</sup> Quarter 2016 through the 2<sup>nd</sup> Quarter 2018. Specific queries built into Microsoft SQL, Microsoft Access, and Microsoft Excel evaluated the database for compliance with applicable state and federal requirements. The database review assessed the following areas noted below:

1. Regulatory Rule Applicability and Component Assignment
2. Difficult to Monitor (DTM) Designations
3. Unsafe to Monitor (UTM) Designation
4. Difficult to Monitor (DTM) Percentage Cap
5. Stream Physical State and Description
6. Monitoring Pace
  - a. Daily (Inspector)
  - b. Daily (Instrument)
  - c. Hourly (Inspector)
  - d. Hourly (Instrument)
7. Instrument and Inspector Documentation
8. Monitoring Time
9. Initial Monitoring
10. Initial Second Monitoring
11. Monitoring Completeness and Timing
  - a. Valves
  - b. Pumps
12. Initial Attempt at Repair
13. First Attempt at Repair
  - a. Valves
  - b. Pumps
  - c. Connectors
14. Final Attempt at Repair
  - a. Valves
  - b. Pumps
  - c. Connectors
15. Delay of Repair (DOR)
16. Follow-up Inspection Completeness
  - a. Method 21 Inspections
  - b. Visual Failing Inspections
17. Chronic Leakers
18. Repair History

### **3.3 Component Identification**

The auditors evaluated component identification while onsite. The component identification review specifically focused on misidentified equipment, untagged equipment, and new components on regulated process lines. This evaluation occurred in the same units as comparative monitoring, covering approximately 95% of the regulated normal to monitor valves in the process areas combined.

### **3.4 Onsite Field Observations**

Several site technicians were observed by the audit performing calibrations, Method 21 monitoring, and managing leaks found. The technician that escorted the audit team was observed confirming leaks, tagging, and working with repair technicians for first attempts at repair.

Finally, the auditors also evaluated compliance for Open Ended Line (OEL) control, sample station flushing control, and discussed the LDAR Program Quality Assurance/Quality Control (QA/QC) procedures with refinery personnel.

**4****COMPLIANCE FINDINGS**

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In this section, the audit compliance findings are documented based on the audit area.

**4.1 Comparative Monitoring**

No compliance findings.

**4.2 Recordkeeping**

The recordkeeping review produced one (1) finding of at least one or more missed initial monthly monitoring event on a newly installed valve.

The recordkeeping review produced one (1) finding of one missed monthly monitoring event on a pump.

The recordkeeping review produced one (1) finding of at least one or more valves leaking above 500 ppm that did not have documentation of a first attempt at repair within the required 5-day timeframe.

The recordkeeping review produced one (1) finding of at least one or more pumps leaking above 2000 ppm that did not have documentation of a first attempt at repair within the required 5-day timeframe.

The recordkeeping review produced one (1) finding of at least one or more pumps leaking above 2000 ppm that did not have documentation of a final repair within the required 15-day timeframe.

The recordkeeping review produced one (1) finding of one or more valves that did not receive the require 2 monthly follow-up inspections after leaking above 500 ppm.

**4.3 Component Identification**

The field observations produced zero (0) findings of components which are in Light Liquid or Gas Vapor VOC service but are not included in the LDAR Program.

**4.4 Onsite Observations**

The field audit produced one (1) finding of improper Open-Ended Line controls.

There were no compliance findings identified during the technician observations, MOC, and QA/QC reviews.



## 5

**PROGRAM STRENGTHS**

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This recognition of program strengths commends the site for their continuing efforts to improve the LDAR Program, while providing a balanced audit perspective. Listed below are some of the program strengths identified during the audit.

- Demand-Flow Regulators: The Site is using demand flow regulators for their calibration gases, this is an industry best practice and a highly effective calibration method.
- Component Identification and Tagging: Component identification was in excellent condition, areas that are commonly overlooked (e.g. pump seal pots, components under compressor decks, etc.) were appropriately tagged.

## 6

## AUDIT STATISTICS AND ANALYSIS

Presented below are the results of a statistical analysis of the audit.

### 6.1 Comparative Monitoring Result

Section 6.1.1 discusses the level of agreement between the comparative monitoring leak rates and the site historical average leak rates. Section 6.1.2 explains the significance of these results based upon the statistical analyses.

#### 6.1.1 Comparison of Leak Rates

The audit team conducted comparative monitoring of normal to monitor valves in three (3) units. The audit leak rates were higher than the average site reported historical leak rates in two units, and nearly identical in the third.

**Table 6-1: Audit Valve Leak Rate Comparison**

Audit Area	Audit Leaks	Audit Inspections	Leak Rate	
			Audit	Site Avg.
Selected Units	3	740	0.41%	0.26%
ISO 2	2	270	0.74%	0.34%
Ref 3	1	245	0.41%	0.30%
BGOT	0	225	0.00%	0.03%

The auditors found four (3) leaks among the 740 valves monitored for an overall comparative monitoring leak rate of 0.41%. For the same units the site reported a combined average historical valve leak rate of 0.26%.

The audit team conducted comparative monitoring of pumps in three (3) units. The audit leak rates matched the average site reported historical leak rates in all three units.

**Table 6-2: Audit Pump Leak Rate Comparison**

Audit Area	Audit Leaks	Audit Inspections	Leak Rate	
			Audit	Site Avg.
Selected Units	0	44	0.00%	0.58%
ISO 2	0	20	0.00%	0.90%
Ref 3	0	9	0.00%	0.00%
BGOT	0	15	0.00%	0.83%

The auditors found one (0) leak among the 32 pumps monitored for an overall comparative monitoring leak rate of 0.00%. For the same units the site reported a combined average historical valve leak rate of 0.58%.

#### **6.1.2 Statistical Analyses of Comparative Monitoring Results**

Aside from the leak ratio agreement, the audit looked at the probability value of the Chi-Squared test statistic and 95% Confidence Interval. The Chi Square statistic is a non-parametric test, which indicates the probability that both leak rate results are describing the same population. It should be noted that Chi Square does not assume that the audit leak rates are correct; it simply measures the degree of similarity between the site's historical leak rate data and the audit's leak rate data. Two of the three units showed good statistical agreement, and the overall statistical agreement was also good.

Table 6-3 Statistical Analysis of Audit Valve Leak Rate Data

Area	Audit Leak Rate	Site Average Leak Rate	Site Min Leak Rate	Site Max Leak Rate	Leak Rate Ratio	Std. Dev.	95% Conf. Interval	Chi-Square P Value
Selected Units	0.41%	0.26%	0.02%	0.88%	1.54	0.36%	0.57%	35.21%
ISO 2	0.74%	0.34%	0.00%	1.26%	2.19	0.53%	0.85%	29.38%
Ref 3	0.41%	0.30%	0.08%	0.83%	1.36	0.30%	0.49%	76.17%
BGOT	0.00%	0.03%	0.00%	0.11%	0.00	0.05%	0.07%	79.97%

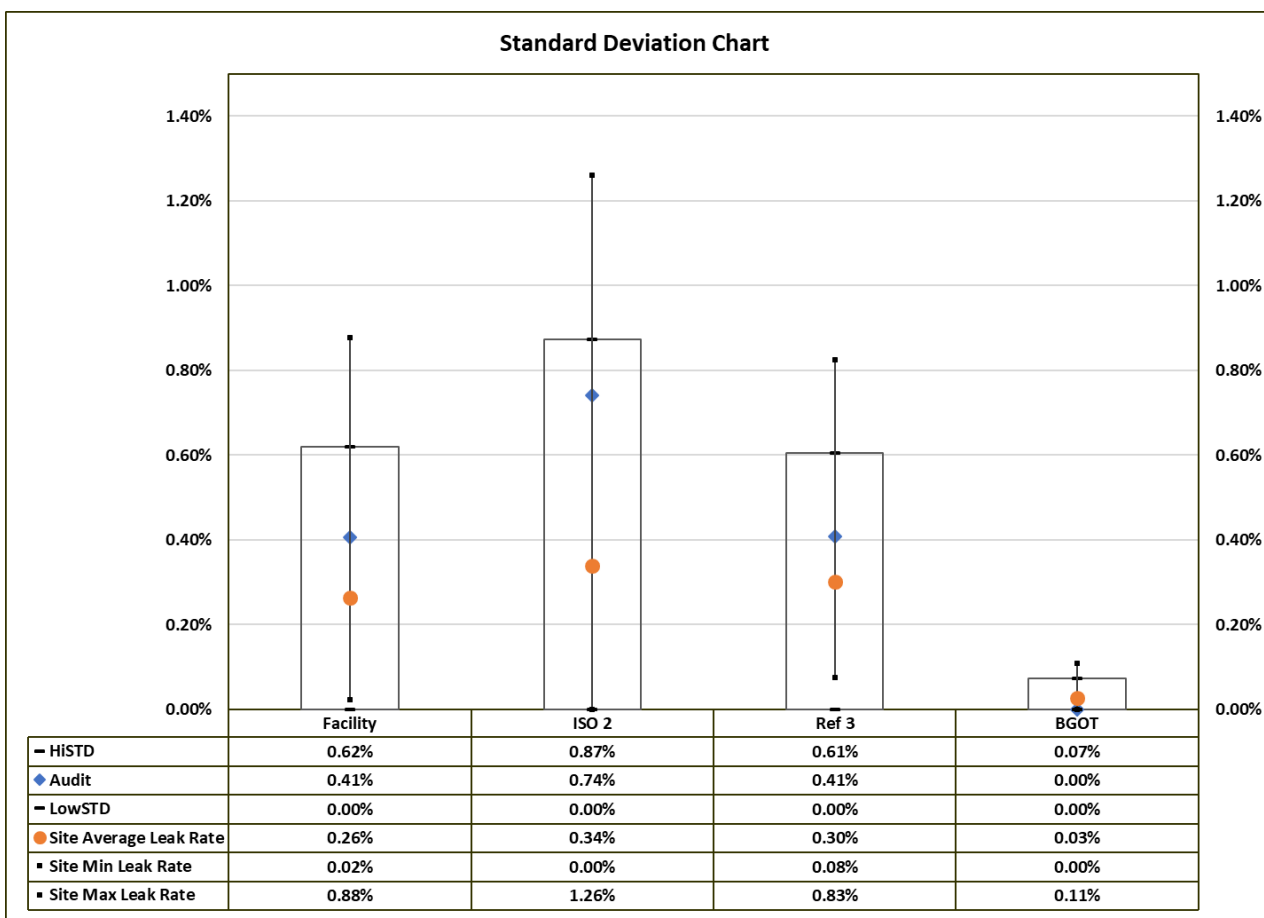


Figure 1: Graphical Representation of the Statistical Agreement Around the Standard Deviation

Probability (P) Values below 5.0% reject the null hypothesis that the audit and site monitoring have statistical representation or more simply that the site monitoring and audit monitoring data are statistically different. None of the three units failed this test, indicating good agreement between site and audit monitoring results.

The 95% Confidence Interval is a value indicating how significant a population varies. If the individual observations in the population vary significantly from the mean, then the 95% Confidence Interval will be large. However, if the individual observations in a population are close to the mean then 95% Confidence Interval will be small.

The statistical interpretations of the comparative monitoring presented in Table 6-3 and Figure 1 are:

**ISO 2:** Good Result – The audit leak rate was higher than the site historical average. The test statistics showed agreement with the site data and the leak ratio is below three and passes comparative monitoring.

**Ref 3:** Good Result – The audit leak rate was higher than the site historical average. The test statistics showed agreement with the site data and the leak ratio is below three and passes comparative monitoring.

**BGOT:** Very Good Result – The audit leak rate was slightly lower than the site historical average. The test statistics showed agreement with the site data and the leak ratio is below three and passes comparative monitoring.

**Facility:** Good Result – Overall, the audit found a higher leak rate than the site average for all three units. All three units show good statistical agreement. The aggregated data over the three units show good agreement, and the leak ratio is below three and passes comparative monitoring.

**Table 6-4 Statistical Analysis of Audit Pump Leak Rate Data**

Area	Audit Leak Rate	Site Average Leak Rate	Site Min Leak Rate	Site Max Leak Rate	Leak Rate Ratio	Std. Dev.	95% Conf. Interval	Chi-Square P Value
Selected Units	0.00%	0.58%	0.00%	0.00%	0.00	0.00%	0.00%	58.04%
ISO 2	0.00%	0.90%	0.00%	5.56%	0.00	0.53%	0.85%	67.47%
Ref 3	0.00%	0.00%	0.00%	0.00%	0.00	0.30%	0.49%	N/A
BGOT	0.00%	0.83%	0.00%	10.00%	0.00	0.05%	0.07%	72.78%

Probability (P) Values below 5.0% reject the null hypothesis that the audit and site monitoring have statistical representation or more simply that the site monitoring and audit monitoring data are statistically different. One of the three units had no leaks over the audit period, and hence this test is not valid for that unit. The other two units had reasonable P Values, indicating good agreement between site and audit monitoring results.

The 95% Confidence Interval is a value indicating how significant a population varies. If the individual observations in the population vary significantly from the mean, then the 95%

Confidence Interval will be large. However, if the individual observations in a population are close to the mean then 95% Confidence Interval will be small.

The statistical interpretations of the comparative monitoring presented in Table 6-4 are:

**ISO 2:** Excellent Result – The audit leak rate was lower than the site historical average. The test statistics showed agreement with the site data and the leak ratio is below three and passes comparative monitoring.

**Ref 3:** Excellent Result – The audit leak rate was the same as than the site historical average. The leak ratio is below three and passes comparative monitoring.

**BGOT:** Excellent Result – The audit leak rate was lower than the site historical average. The test statistics showed agreement with the site data and the leak ratio is below three and passes comparative monitoring.

**Facility:** Excellent Result – Overall, the audit found a lower leak rate than the site average for all three units. All three units show good statistical agreement. The aggregated data over the three units show good agreement, and the leak ratio is below three and passes comparative monitoring.

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## CONCLUSIONS

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Overall, the BP Husky Toledo Refinery has a very strong LDAR program that is doing a good job limiting fugitive emissions. There will always be areas for improvement in an enterprise with as many moving parts as LDAR, but the program here appears to be in good condition and moving towards continued improvement.